

JAPAN LOOKS TO RESIDENTIAL FUEL CELLS

Fuel cells have many advantages that give them great potential as distributed cogeneration devices -- providing electricity, heat, and hot water -- to residential customers. They are small, clean and quiet, and they can be easily sited in the most congested urban locations. This allows utilities to meet new or peak demand for electricity without building central stations and without substantially expanding or upgrading the grid. These advantages are making residential fuel cells a top priority for Japan.

The Japan Gas Association, with \$7.3 million in funding from the Japanese Government has embarked on a five-year effort to commercialize residential fuel cells through the Millennium PEFC Program. The principal aim of the program, which began in 2000, is to test proton exchange membrane fuel cells (PEM or PEFC) and collect technical data for establishing codes and standards required for the introduction of commercial models.

The involvement of the Japan Gas Association reflects the fact that Japanese gas companies are the key drivers behind residential fuel cells in Japan. Since these systems will likely be fueled by reformed natural gas, the gas companies view fuel cells as a way for them to significantly

expand their business.

Most residential systems being developed in Japan are in the 1kW range, reflecting the smaller size and lower power consumption of the average Japanese household. In addition, Japanese systems are smaller because they are being designed to operate in urban areas and provide power in parallel with the grid.

The two leading forces in this move to bring residential fuel cells to market are the two biggest gas companies in Japan -- Tokyo Gas and Osaka Gas. Tokyo Gas is the largest natural gas company in Japan both in terms of the number of customers -- over 8.5 million in total -- and annual gas sales volume -- over 9 billion cubic meters. The company was founded in 1885 and its service area covers the heart of the Kanto region, Tokyo, and neighboring prefectures, the largest and most densely populated region in Japan with a total of some 40 million people. Osaka Gas is Japan's second largest gas company serving over 6.4 million customers in the Kansai area of Japan. The company was founded in 1897 and has an annual gas sales volume of over 7 billion cubic meters.

In Japan, the residential market is the largest user of gas providing 37.9% of total sales, and the gas companies are rapidly cutting deals to try to get fuel cells to market. Tokyo Gas' main initiative is a joint venture with Ballard Generation Systems (BGS) and its Japanese partners -- EBARA BALLARD and EBARA Corporation. In early-2000, the four companies signed an agreement to develop a natural gas-fuelled fuel cell targeted at the Japanese residential market. The agreement involves collaboration in the development of a fuel processor, which will be incorporated by EBARA BALLARD in a 1kW PEM fuel cell power generator. The cogeneration unit will provide electric power for Japanese homes and apartments as well as heat for space heating and hot water. "Tokyo Gas is committed to finding residential power solutions that will meet the needs of our customers while also reducing emissions of greenhouse gases," said Yasuyuki Yamaguchi, senior managing director of Tokyo Gas. "We see PEM fuel cell technology as the best new technology to deliver clean, reliable and cost-effective onsite residential power generation to our customers."

This venture has so far produced a 1kW engineering prototype which reached DC gross electrical efficiency of 42 per cent, and heat recovery efficiency of 43 per cent in in-house testing. The unit is comprised of a Ballard fuel cell, Tokyo Gas technology in a reformer made by EBARA BALLARD, and a water tank warmed with heat from the fuel cell. Four prototype units built at EBARA BALLARD's plant in Fujisawa, Japan, have been shipped to Tokyo Gas and others in Japan for testing and demonstration. "This fuel cell generator will provide electric power for Japanese homes and apartments as well as heat for space heating and hot water," said Jim Kirsch, President of Ballard Generation Systems. "The performance of the prototype unit is testimony to the effectiveness of our collaboration with EBARA and Tokyo Gas." Tokyo Gas is planning a large-scale test implementation in residential homes in 2004.

Osaka Gas, on the other hand, is hedging its bets by working with multiple companies. In March 2001, Osaka Gas announced plans to work with H Power to develop a new 500-watt residential cogeneration fuel cell system for the Japanese market. The new unit will incorporate H Power's proprietary fuel cell technology and Osaka Gas' proprietary steam reforming technology, which Osaka Gas will transfer to H Power nonexclusively through H Power's marketing partner in Japan -- Mitsui. Yuji Matsumura, head of technology and managing director of Osaka Gas, commented, "We believe that our reformer technology, combined with H Power's cogeneration fuel cell expertise, is a marriage of world-class technologies that will produce an efficient, cost-effective fuel cell system well suited to the residential and apartment markets. We look to offer compact one-kilowatt and 500-watt systems in Japan where the demand for low-power alternative energy sources is strong."

This project has already proven successful as recently Osaka Gas began long-term operational trials of an H Power 500-watt system. The system provides primary power and hot water, and has been installed in Osaka Gas' NEXT21, which is an experimental condominium complex located in Tennouji Ward, Osaka City. The

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current test is planned to last one year, and Osaka Gas plans to continue test operations after that on improved prototypes until 2005. During this period, Osaka Gas plans to expand the number of systems installed in residential homes. According to Matsumura, "With the beginning of the current test, the development of residential PEM cogeneration systems has entered a new stage aimed at commercialization."

A few months after the H Power deal was announced, Osaka Gas entered into a similar agreement with Sanyo Electric to jointly develop a 1kW residential PEM fuel cell. Sanyo and Osaka Gas plan to develop a cogeneration system capable of generating 1kW by 2003 so that they can start marketing it by 2005.

And finally, Osaka Gas has followed Tokyo Gas' lead in joining with Ballard Generation Systems, EBARA Corporation, and EBARA BALLARD. EBARA BALLARD will design a cogeneration power generator able to provide electric power for Japanese homes and apartments, as well as heat for space heating and hot water. Ballard and EBARA Corporation will provide support for the project. The generator will incorporate Ballard fuel cells with a compact fuel processing subsystem developed by Osaka Gas. "This advanced relationship shows our progress towards the goal of commercializing residential fuel cell power generation technology in a number of markets in Japan," said Mike Murry, Ballard's general manager, Power Generation Division.

But, the gas companies aren't the only ones trying to get fuel cells to the Japanese public. Mitsui and Nuvera Fuel Cells have signed a Memorandum of Understanding to create a joint venture company that will, in its initial phase, conduct a feasibility study for the production and distribution of fuel cell systems for the Japanese market. Upon completion of the feasibility study, the companies, with additional Japanese partners, expect to develop, manufacture, market, distribute, and service integrated fuel cell power systems designed for premium power, residential,

and commercial applications. "Fuel cells represent one of the world's great innovations whose time has come," said Toshiyuki Hayashi, general manager of Mitsui's Industrial Machinery Division.

Other fuels are also being looked at to power residential fuel cells. Kamata Inc., a propane distributor serving a group of 800,000 consumers, has installed and is field-testing one of H Power's 4.5 kW Residential Cogeneration Units (RCU) at its Gotenba employee facility in Gotenba-city, Japan. This installation marks the first field test of a propane-powered PEM system for an actual load in the Japanese residential market. The propane-powered unit is being used to provide the electricity, heat and hot water requirements of a home owned by Kamata for the use of its employees. Kamata will field test this unit and provide all the test data to H Power to assist in completing the development of a commercial version of the RCU for Kamata's customer base.

Tokyo Boeki, a Japanese trading and marketing company, has executed a long-term license and distribution agreement with IdaTech for its patented fuel cell systems. Under the terms of the agreement, Tokyo Boeki will represent IdaTech in the manufacture, distribution and sales of fuel cell components and systems in Japan and 13 Asian countries. The agreement includes a multi-year, multi-million dollar purchase agreement that includes joint development to "localize" IdaTech's fuel cell technology for the Japanese market. "Fuel cell technology represents a vast new industry that can help us meet the mushrooming market demand for energy in Japan and, indeed, all of Asia," said Kazuei Uchida, Tokyo Boeki's chief operating officer for overseas machinery sales division. The initial test systems will operate on methanol and, possibly, other fuels.

Other residential fuel cell development efforts in Japan include Matsushita, which has developed a compact residential PEM cogeneration system, and began testing a 1.5kW prototype in January 2000; Fuji, which has developed a 1kW PEM stack

with sixty cells that operates without external humidification, and has been successfully operated for 20,000 hours, running off reformed gas; and Toshiba, which established a joint venture with UTC Fuel Cells to concentrate on the development and commercialization of a 1kW PEM residential cogenerator, a prototype of which has already been displayed, running off natural gas.

Prototypes of these systems are now being evaluated by the Japan Gas Association as part of its residential PEFC program and all three companies expect to be selling them commercially in the 2004-2005 time frame. Matsushita says its 1.3kW unit will sell for 1 to 1.2 million yen (US\$8,300 to US\$10,000). Toshiba is more optimistic and says its 1kW units will initially cost around 400,000 to 500,000 yen (US\$3,300 to US\$4,100).

Recognizing that Japan is where the action is, Mosaic Energy, a U.S. fuel cell developer has decided to relocate the company's fuel cell commercialization efforts, including its initial product offerings and market entry, to Japan. Ishikawajima-Harima Heavy Industries (IHI), one of Mosaic's owners, will create a Mosaic fuel cell stack manufacturing capability in Japan, with the intent of integrating these stacks with fuel cell components developed and manufactured by IHI. Earlier this year, Mosaic shipped two 6.6kW fuel cell stacks to IHI for use in demonstration projects. "Mosaic Energy is still very focused on the U.S. market and its enormous potential," said Gerry Runte, president of Mosaic Energy, "but we see the U.S. market as a later opportunity for our products. The Mosaic Energy stack technology, combined with IHI's balance-of-plant and market channels in the Pacific Rim, will be afforded a much earlier opportunity for demonstration and commercialization in Japan than in the United States."

These efforts clearly demonstrate Japan's belief in the validity of using fuel cells for residential customers. Only time will tell if they are right.

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SCHOOL SYSTEM LEARNS FROM EXPERIENCE

While many think that fuel cells are still far away from being a real alternative to grid power, a school system in New York has learned that the alternative is already here. OCM BOCES (the Onondaga, Cortland, Madison Board of Cooperative Educational Services) is a state entity that supports, through its regional information center, more than 50 school districts in New York state.

In early 1997, OCM BOCES installed a 200 kW phosphoric acid fuel cell manufactured by UTC Fuel Cells. In addition to supplying 75-100% of the facility's power needs, steam emitted from the unit is used for heating throughout four zones of the facility providing more than 700,000 Btu per hour of usable heat for the 29,000 square-foot building.

The serious ramifications of power disruptions were the primary driver for evaluating and implementing a distributed generation system. Power outages and small interruptions caused serious damage to occur to the facility's mainframe resulting in significant downtime for the system. "We're located in an area where we have decent power, but a lot of the time you'll have a glitch or a problem with a transformer," said Mike Fay, Director of Facilities & Operations. "The mainframe is so sensitive that it automatically would shut down. By having the ability to not worry about damaging your mainframe or having your mainframe go down, having this technology has helped us dramatically."

Bringing the system back up was time consuming and expensive, while also disrupting the educational process. Finding a source of reliable high-quality power; therefore, was of primary concern. "Having the clean power when everyone else is down, it sure is nice to know that you're not going to be working on your mainframe for the next day and that you're not going to have students have their educational atmosphere disrupted," said Fay.

OCM BOCES decided to go with a fuel cell after evaluating other distributed generation technologies that would satisfy their requirements of achieving a seamless and uninterrupted flow of power. "We looked at other forms, but the fuel cell at the time appeared to be the one that would fit our need," said Fay. "Not only because of what it provided us, but it was a new technology that was not getting enough

attention. We looked at everything -- how is the thing going to function, are we going to have good, reliable power, is it going to be good, clean power which is extremely important to us."

In addition, as an educational facility, they felt that reducing the ecological impact of their power choice by utilizing a clean source of power was important to the organization. The low emissions associated with fuel cells; therefore, fit their overall philosophy. "Being an educational facility, we always want to think about the ecological impact that could be negative for many energy producing entities versus a fuel cell which has zero or very little emissions," said Fay. "It's something that was very important to us. We're dealing with students and kids. The last thing you want to do is be producing power and polluting the atmosphere."

Cost reduction wasn't a big driver in the decision, but cost was a concern. Project costs totaled \$800,000 with grants received from the New York State Energy

"It was not a difficult sell because of our reasoning behind eliminating some costs that we were incurring based upon our network being down"

- Mike Fay

Research and Development Authority (NYSERDA) and \$200,000 provided by the U.S. Department of Defense Climate Change Project. "Cost is obviously always a concern," said Fay. "There was some money available through some grants which we are fortunate to have taken advantage of. There was some state NYSERDA money. Also there was a Department of Energy grant. Without the grants, I think we would probably have had to really look a little bit harder at the project and we may have had to put the project off. The grants definitely helped."

And while the project wasn't based on reducing energy costs, the higher power quality did have an economic impact. "It was not a difficult sell because of our reasoning behind eliminating some costs that we were incurring based upon our network being down," said Fay. "Whenever you had a blackout or a brownout from the

utility, we would lose the mainframe. Associated with the downtime of the mainframe is the cost of bringing the mainframe back up and getting everything back up on line. The time commitment with technical support people was astronomical. You can eventually put a price on that."

Although exact savings have not been estimated, the organization is realizing energy savings as well as savings through reduction of unscheduled down time and interruptions to the education process. "We do see a savings in our energy cost," said Fay. "In the long run we really anticipate that once we get a good analysis of the costs of our unscheduled down times, we'll really get a fair figure to do an analysis from. To put an exact figure on having the mainframe down, that's something that we really need to work on."

Fay is extremely pleased with the improved reliability and availability that they've gotten with the fuel cell system, which has operated for more than 22,000 hours and has eliminated brownouts, weather-related power failures, and other power interruptions. "We been extremely diligent on sticking to our maintenance schedule and it's really paid off where we've gone to about 94% reliability, which is outstanding considering we have quarterly and annual shutdowns included in that," said Fay. "Our availability and reliability has been extremely good in the last year and a half to two years, and we're currently looking at the possibility of another fuel cell right now."

While the system is working well, it's not without problems. "We've had it go down," said Fay. "We've had pump failures and fan units, we've had things like that occur. It's mechanical, so you're going to end up with some things. But, for the most part I'm very supportive, and a big advocate for fuel cell technology."

Fay thinks that fuel cells are for real and that more businesses would consider them if they had more knowledge about them. "Anytime you promote something that's new, you're going to have hurdles to jump over and you're going to have people watching how you jump over those hurdles," said Fay. "You're going to see people that were a little bit skeptical want to voice their skepticism. Until you get a fair chance at utilizing new technology, I think it's very easy for someone to take the negative angle on things."

IS CANADA LOSING ITS LEAD?

Canada has long been viewed as the leader in the race to commercialize fuel cells. It's the home of industry stalwarts such as Ballard Generation Systems, Fuel Cell Technologies, Hydrogenics, Global Thermoelectric, Energy Visions, and Astris Energy. However, some in Canada are now saying that Canada could lose its leadership position in fuel cells unless a national strategic partnership between government and industry is quickly implemented.

The Canadian federal government has been involved with fuel cells since 1974, when it established a coordinated program on energy R&D involving a number of departments and agencies. From 1975 to 1985, Natural Resources Canada (NRC) ran a Hydrogen and Energy Storage Program. Following the phase out of the NRC Energy Program in 1985, the Ministry of Energy Mines and Resources (now known as NRCan) took over the Government lead in fuel cell and hydrogen technology for industrial commercialization. The government has invested close to C\$150 million in fuel cell technology in the form of grants, contributions, loans and contracts over the last 20 years. Provincial government support has mostly come from British Columbia (BC) and Quebec. BC has invested close to C\$22 million over the years in Ballard, a local firm, and Quebec has invested more than C\$5 million on fuel cell technology in the last few years.

However, a new report by Fuel Cells Canada and PricewaterhouseCoopers (PWC) says this may not be enough. The PWC report states that the level of government support has not kept pace with the needs of the industry or the investments being made by other countries. PricewaterhouseCoopers managing partner for British Columbia and study leader, John Webster, says partnerships between government and the fuel cell industry are critical to sustain Canada's leadership position. "The industry needs to work with government so that the policies and resources are put in place to keep Canada at the leading edge of fuel cell development. In particular, the industry must capitalize on its competitive advantage in innovation and commercialization."

Fuel Cells Canada is an association representing 46 companies in the fuel cell sector. Its chairman, Ron Britton, contends that countries like the U.S. and Japan are

investing heavily to help their fuel cell sectors overtake Canada. The U.S. in particular has become strongly focused on the potential economic benefits of fuel cells and the hydrogen economy. "From the federal administration in Washington D.C. down to state governments, substantial incentives are being offered to the fuel cell sector. Almost every day new initiatives are announced and U.S. state officials are actively encouraging Canadian companies to relocate south of the border," said Britton.

The complaint that the Canadian government is not doing enough to help looks strange to some since in February 2002, Maurizio Bevilacqua, Secretary of State (Science, Research and Development) announced a C\$19 million investment, in a DuPont Canada fuel cell project that will focus on the development of advanced fuel cell components. One of the project's key goals is to introduce innovations that will reduce the cost of manufacturing fuel cell systems, making the technology more economically viable as an alternative clean-energy source for a range of applications including cell phones and computers.

"With this investment, Canadian expertise will stay at the forefront of a technology that promises substantial economic environmental benefits for Canada and the rest of the world," said Secretary of State Bevilacqua. "This project's success would represent a dramatic boost for the emerging fuel cell industry, bringing with it a range of new opportunities for Canadian high-tech sector. The federal government is committed to working in partnership with innovative companies to generate highly skilled jobs and strong growth in every part of the country."

Then in March, Minister of Industry Allan Rock announced that the NRC will increase funding for fuel cell research and development at its NRC Innovation Centre in Vancouver, B.C., by a total of C\$20 million over the next five years to C\$40 million per year. "This announcement is a vote of confidence in fuel cell and hydrogen technologies and British Columbia's innovation," said Minister Rock. "Today's announcement supports Canada's Innovation Strategy and will also support the development of a BC Fuel Cell technology cluster."

Even more recently, in June, Minister Rock and Competition, Science and Enterprise Minister Rick Thorpe

announced that six fuel-cell projects in British Columbia are getting nearly C\$5.2 million in joint funding from the Government of Canada and the Government of British Columbia under the Western Economic Partnership Agreement. "These fuel cell projects demonstrate a clean and viable technology of unlimited potential," said Minister Rock. "They demonstrate the Government of Canada's ongoing commitment to environmental technology development through the Innovation Strategy and compliment our continued investments in fuel cell research."

The six fuel-cell demonstration projects that received funding include: a prototype of a fuel-cell-powered industrial truck; a small-scale hydrogen generator unit; a 'working' multi-fuel warehouse; a sustainable, integrated fuel-based system to generate electricity; a hydrogen fuelling station for fuel cell vehicles; and a 1.2 kW utility standby fuel-cell system.

So is Canada falling behind? While these recent announcements indicate significant government funding, they just don't compare to the spending that the U.S. is doing. The U.S. government is currently providing \$120 million each year for fuel cell development through the Departments of Energy, Defense, Transportation and the Environmental Protection Agency. That's approximately four times what the Canadian government is spending per year. And in 2003, the U.S. plans to spend an additional \$150 million just on the FreedomCar project, an initiative to develop fuel cell-powered vehicles. This compares to the C\$23 million over five years allocated to the Canadian Transportation Fuel Cell Alliance.

And that's just federal dollars. In the U.S., states are also getting into the act. Massachusetts has an \$100 million fund that it is spending on renewable energy, including fuel cells; Connecticut has a similar fund and has already committed \$6 million this year to fuel cells; and Ohio Governor Bob Taft has announced \$25 million for fuel cell R&D and commercialization projects over the next three years.

The reason these governments are spending so much on fuel cells isn't just a reflection of their environmental values. It's more a reflection of their economic ones. PricewaterhouseCoopers forecasts that fuel cells will be a \$46 billion business

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RULE 21 OPENS DOOR TO INTERCONNECTION

The existing power system was developed in an era of large, centralized, generation stations interconnected with a high voltage transmission grid. Since the system developed with relatively few interconnection requests and all of a large nature, no one really thought about interconnecting lots of small generators such as distributed generation systems. Therefore, as distributed generation technologies have developed, customers attempting to implement them have found that most utilities had no standard of scaled-down requirements for interconnection. California was a good example of this situation.

California's interconnection requirements were determined, in part, by the California Public Utilities Commission (CPUC) and Rule 21, which specifies the interconnection, operating and metering requirements for these generators. As technology and the energy market have evolved, Rule 21 has proved to be burdensome for distributed generation systems that could not afford exorbitant time delays and connection costs. Some companies that wanted their own distributed generation systems were told it could take as long as a year before the local utility could make the proper connections to let the system operate. As a result, many would-be distributed generation projects were put on hold or cancelled entirely. Applications to build more of these smaller yet efficient plants virtually disappeared during the 1990s.

However, as the state entered deregulation, the California Energy Commission (CEC) took action to revise Rule 21 so that distributed generation could become a reality in the state. In November 1999, after a series of public workshops and meetings, the CEC issued an Order Instituting Investigation to encourage more development in distributed generation. After identifying barriers and developing solutions to remove those barriers, the CEC presented its findings to the California Public Utilities Commission (CPUC) for consideration. On December 21, 2000, the CPUC approved in its entirety the Rule 21 language adopted by the California Energy Commission. Today, the three major investor-owned utilities in the state have now replaced their former Rule 21 with the approved Model Tariff, Interconnection Application Form, and Interconnection Agreement.

By streamlining Rule 21, the state has opened a window of opportunity for distributed generation to make a considerable impact in the state. In adapting Rule 21 to the realities of the energy marketplace, California has already achieved significant reductions in costs for interconnection across all project sizes. However, the greatest cost reductions are predicted to occur for distributed generation projects less than 1 megawatt in size.

One of the key elements behind the new streamlined approach to interconnection is speeding up the initial review process for distributed generation applications that qualify for what is known as "simplified interconnection." If the applicant qualifies for simplified interconnection, then the utility must complete its initial review, absent any extraordinary circumstances, within 10 business days. If the initial review determines that the proposed facility can be interconnected by means of a simplified interconnection, the utility must provide the applicant with a written description of the requirements for interconnection and a draft interconnection agreement.

Another important element in the new Rule 21 is a reduction in the delays once associated with certification of generating equipment. Now, if a nationally accredited lab has tested and certified a distributed energy generator, then in many cases the small plant may be installed without further utility review. Capstone Turbine Corp. has become the first company to successfully take advantage of the Rule 21 certification process.

In February 2002, the CEC certified the 30 and 60 kW Capstone MicroTurbine energy systems as complying with the requirements of its Rule 21 grid interconnection standard. CEC certification to the Rule 21 standard essentially reduces the interconnection review process from, at times, upward of one year to a targeted 2 to 3 weeks with significant cost savings. "We are pleased that our innovative micro-turbine systems have now officially been certified as being safe for interconnection to the grid. We think this is a significant step toward growing distributed generation market access in California, and for Capstone differentiating its products in the California market," said Dr. Ake Almgren, president and CEO of Capstone Turbine Corporation.

While Capstone was the first to be cer-

tified, Plug Power wasn't far behind, as in June it received CEC certification for its 5kW stationary fuel cell system. Companies whose systems lack this certification will be required to have their systems individually tested and certified by the utility, adding cost and time to the installation process. "Interconnection to the electric grid is a critical element in developing a viable distributed generation project," said Plug Power CEO and president Dr. Roger B. Saillant. "The Rule 21 certification will significantly accelerate our process of 'order to operation'. Now that Plug Power is certified in the state of California for grid-interconnection, we believe we can manufacture, deliver, install and connect a fuel cell system within 10 weeks."

While the Rule 21 changes implemented in 2000 have helped ease implementation of distributed generation, they aren't the final solution. The Rule 21 working group, which holds monthly meetings, is beginning to look at the issue of distributed generation systems that fail one or more of the screening steps in the existing state Initial Review Process (IRP). For example, when the IRP was initially developed, net-metered systems were considered outside the scope of Rule 21 because of their small size and so were not considered. With the advent of California bill ABX1 29, which raised the net-metering limit from 10kW to 1MW, a need was identified for additional scrutiny of larger net-metered systems.

The Rule 21 workgroup plans to attempt to develop additional screens and review criteria for larger net-metered systems. The intent is to develop a Supplemental Review process that will subject these systems to an appropriate set of requirements and level of scrutiny and, for the larger systems, provide reasonable additional requirements based on the size of the system and the characteristics of the installation. The utilities are supposed to file a report with the CPUC on the cost issues on September 1, 2002 in order to determine whether significantly different costs are incurred based on project size.

California is not the only state that has standardized interconnection for distributed generation systems; New York and Texas have also. Hopefully, other states will follow their lead and make it easier for distributed generation to penetrate the marketplace.

MASSACHUSETTS BACKS DISTRIBUTED GENERATION

While a lot of people are talking about the future potential of distributed generation, the state of Massachusetts is working to make it a reality. In 1997, when Massachusetts decided to restructure its electric industry, the state legislature passed a law to place a charge on each kilowatt-hour of electricity purchased -- roughly 50 cents per month for a residential customer -- in order to support a broad range of activities related to renewable energy.

The money garnered by this charge is collected by distribution companies and transferred in whole to the Massachusetts Renewable Energy Trust Fund (RET). As of December 31, 2001, the charge had generated almost \$169 million and is expected to yield a total of \$202 million by the end of 2002. The RET is run by the Massachusetts Technology Collaborative (MTC), an independent, economic development organization.

In creating and funding the Renewable Energy Trust Fund, the Massachusetts Legislature directed MTC to leverage RET assets to generate the maximum public benefits from renewable energy over time to the citizens of the Commonwealth. These public benefits are to be measured principally by increases in the amount of renewable energy generated and consumed in Massachusetts but also by an expansion in the economic activity associated with the Commonwealth's cluster of renewable energy and related firms and enterprises. "The primary goal of the Massachusetts Renewable Energy Trust is to help the Commonwealth shift toward a greater reliance on renewable energy resources to meet the state's energy needs," said Greg Watson, director of the RET.

One of the major elements of RET's strategic plan is to promote greater use of renewable energy technologies in distributed generation. "Distributed Generation offers the promise of providing electricity in fundamentally different ways -- dispersed, on-site, small-scale sources of electricity capable of providing power to individual buildings, communities and the grid," said Joseph Alviani, president and CEO of the Massachusetts Technology Collaborative.

In order to accomplish this, RET plans to undertake a broad range of activities to expand the use of fuel cells, PV systems and other eligible renewable energy technologies in distributed generation applica-

tions. "The Renewable Energy Trust Fund will significantly increase investment in solar power, fuel cells, wind and other forms of clean, renewable energy," said Bob Durand, Massachusetts Secretary of Environmental Affairs and co-chairman of RET's advisory committee.

The RET has four major initiatives which support distributed generation; 1) the Premium Power Program explores and promotes the use of fuel cells as sources of highly reliable power; 2) the Green Buildings Program promotes the joint use of energy efficiency and renewable energy technologies in public and private buildings; 3) the Green Power Pre-Development Program addresses the addition of power from renewable energy sources such as wind, biomass, landfill gas and photovoltaic technology to New England's power distribution grid; and 4) the Solar-to-Market Program is a \$10.0 million commitment to support the development of the Commonwealth's solar energy cluster through innovative applications of solar generation technologies and related work to identify and address market barriers to increased use of these technologies in the Commonwealth.

The premium power program has already taken off with RET awarding planning grants to four organizations to examine the feasibility of using fuel cells to enhance the reliability of power for sensitive loads. "Fuel cells are at the cutting edge of technology in the renewable energy field. Working with leaders from academia, industry and government we are supporting projects that will produce valuable research and case studies to make future applications of these technologies even more successful," said Mitchell Adams, executive director of MTC.

In June 2001, RET awarded \$425,000 to the U.S. Coast Guard for the installation of a molten carbonate fuel cell at its Air Station in Bourne, MA. Electricity generated by the fuel cell will be used to support critical sea & air rescue operations and ensure that a reliable supply of electricity exists during power outages or other emergencies. Residual heat from the fuel cell will be used for hot water, kitchen operations, and building heating. "This is the first-ever fuel cell the U.S. Coast Guard will install for generating electricity," said Dr. Steve Allen, Coast Guard energy program manager. "The efficiency and environmental benefits of fuel cells make this

an exciting new technology for the Coast Guard. We hope to use this as a 'test bed' to evaluate all the potential benefits and opportunities fuel cells may provide for us in the future."

RET has also awarded \$150,000 to the Harvard Medical School and Merck & Co. to investigate the use of a shared fuel cell system for their new research buildings on adjacent parcels in the Longwood Medical Area of Boston, Massachusetts. The proposed system would utilize six fuel cells, producing a total of 1.2 MW. It would be the first of its kind on several counts: the largest of any such private facility in the world; the first use of fuel cells in medical research in the United States; and the first shared use of fuel cells ever installed. "We want to provide high quality and dependable power to our researchers, while reducing our environmental footprint," said Paul Levy, the executive dean for Administration at Harvard Medical School. "Fuel cells seem our best hope for achieving these goals."

Most recently in May, RET awarded a \$150,000 grant to the University of Massachusetts (UMass) Amherst to help determine the feasibility of developing a fuel cell driven premium power supply for facilities on the UMass Amherst campus. Patrick Daly, associate director for Utilities at the UMass Amherst Physical Plant said, "This grant is a great opportunity to study the use of new technologies to address 'real-world' power quality and reliability applications, while also offering the UMass community a chance to conduct research on the design and operation of a fuel cell. We believe that involving the academic areas could serve to fulfill the educational goals of the university and to advance knowledge of fuel cell technology."

RET plans to continue to solicit proposals for premium power for fuel cells, especially for companies engaged in high volume transaction processing, companies operating 24x7 communications/information services, and public safety organizations. RET is particularly interested in the potential of fuel cells to address public health and safety concerns triggered by the threat of power supply disruptions and will explore the potential for working with electric distribution companies to improve the reliability of local distribution networks that are prone to power disruptions.

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BIOGAS, THE NEW FUEL FOR DG

At its January 24, 2002 meeting, the Wisconsin Public Service Commission approved Wisconsin Power and Light Company's (WP&L) Biogas Renewable Energy Distributed Generation (BREDG) Program. The program which has a limit of 10 MW of biogas-fuelled distributed generation is one of the first large-scale trials of biogas as a fuel to generate electricity from these systems.

The BREDG program will serve as a pilot demonstration project to encourage the development of a renewable fuel supply of methane gas -- for distributed generation systems -- derived from farms, landfills, wastewater treatment plants, and food processing plants. "There is a great deal of excitement surrounding the potential increased use of smaller distributed resources in our country," says John Helbling, general manager for Market Development of Distributed Resources for Alliant Energy. "We are looking to move beyond the study stage and obtain some real world experience in demonstrating the customer benefits available through this technology."

The demonstration projects will cover a number of smaller generation technologies such as engines and microturbines and utilize a variety of renewable biogas fuels. "Renewable fuel sources and distributed generation are a natural fit," says Michael Vickerman, executive director of RENEW Wisconsin. "The best way to move from a good idea to a real-life solution is to actually get out and do it. We fully support this effort and look forward to moving well beyond the demonstration phase."

As this Wisconsin effort shows, biogas as a fuel for distributed generation is an idea whose time may have finally come. So what is biogas and how can it be used as a fuel to produce electricity? First, let's start with the definition of biomass. Biomass is any organic matter which is available on a renewable basis through natural processes or as a by-product of human activity. Biomass includes: agricultural crops and wastes, wood and wood waste, energy crops, and municipal solid waste. Biomass can be converted into a fuel gas -- biogas -- in a gasifier. Using this method, sand (at about 1500°F) surrounds the biomass, creating a very hot, oxygen-starved environment. These conditions break apart wood or other biomass, creating an energy-rich, flammable gas. The biogas can be cofired with wood (or other

fuel) in a steam boiler or used to operate a standard gas turbine.

Biogas can also be created by digesting food or animal wastes in the absence of oxygen. This process, called anaerobic digestion, will occur in any airtight container containing a mixture of bacteria normally present in animal waste. Different types of bacteria work in sequence to break down complex chemicals, such as fat and protein, into progressively simpler molecules. The final product is a biogas containing methane and carbon dioxide. The biogas can be used for heating or for electricity generation in a modified internal combustion engine. However, advanced gasification technologies are necessary for converting animal waste to a biogas with sufficient energy to fuel a gas turbine or fuel cell. Landfills also produce a methane-rich biogas from the decay of wastes containing biomass. However, landfill gas must be cleaned to remove harmful and corrosive chemicals before it can be used to generate electricity.

Because biogas fuels are renewable, they help reduce greenhouse gas emissions from fossil fuels. When energy crops are grown for biopower generation, they help preserve cropland, create habitat for wildlife, and prevent soil erosion. On the downside, biogas contains less concentrated energy, is less economic to transport over long distances, and requires more preparation and handling than fossil fuels. These factors contribute to higher costs. Other challenges to the increasing use of biogas include competition with natural gas, the need to develop high-yield, low-input energy-crop farming practices, and the need for more research to improve biopower technologies. In addition, biogas is often not clean enough for standard fuel cells or microturbines, and, on average, it has only 60 percent of the energy content of commercial gas. This requires filters to remove the harmful elements in the gas and dryers to lower the moisture content.

However, if you're a landfill, wastewater facility, or farm, a lot of these downsides don't apply to you. By their nature, these businesses produce significant quantities of biogas as a byproduct. This means that the fuel is available on-site for free. In addition, environmental regulations prevent these businesses from just releasing the methane into the air, so they need to find a way to get rid of it. Using it as biogas to power a distributed generation sys-

tem fills their need.

Environmental Power Corporation (EPC) is one of the companies leading the charge to use biogas as a fuel for distributed generation. In 2001, EPC acquired Microgy Cogeneration Systems Inc., a company with an exclusive license in North America for development of a proprietary technology for highly efficient extraction of methane gas from animal wastes. Microgy also has an exclusive license on a microturbine cogeneration system using this biogas. "EPC believes there are thousands of farms, many in major electric markets, with a pollution control problem that our Microgy technology addresses and in so doing, makes available an off-take of biogas for power production. Electricity produced from this process would make each host farm into a distributed energy site supplying peaking 'green power' that many utilities and energy marketers as well as consumers favor and that the Bush energy proposal supports with significant economic benefits," said Joseph Cresci, CEO of Environmental Power.

EPC is working to put this technology to use. Recently it signed letters of intent with six farms in Wisconsin to build an anaerobic digester system on each site. The systems, which will provide peak electric power to Wisconsin Public Service Corporation, are expected to be operational by August 2003. The methane will be used to produce approximately 10 megawatts of peak power at electric generating facilities to be constructed on the farms and operated by Environmental Power. "The fact that these farms have signed on so quickly to use our technology demonstrates both the urgency farmers place on the resolution of this serious environmental issue and the desirability of the solution offered by Environmental Power," said Donald A. Livingston, president and chief operating officer of Microgy. "Rather than incurring significant costs to address the problem, farmers can actually add to their bottom lines. It is another important step in the process of realizing our mission to produce renewable energy from animal wastes while helping control water and air pollution stemming from animal feeding operations and addressing the nation's need for renewable green power that is both reliable and cost efficient."

The idea of using biogas to fuel devices

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MASSACHUSETTS, CONTINUED FROM PAGE 6

It may be cost-effective to use fuel cells to supplement local distribution systems, reducing the need for costly upgrades.

But fuel cells aren't the only distributed generation technology that the RET is trying to spur. In one of its most ambitious projects, RET awarded \$128,415 to the City of Brockton for predevelopment activities related to converting two "brownfield" sites into a collection of ground level, power generating solar panels. "This proposed solar power project would not only use a renewable resource to produce clean electricity, but also put to use former industrial property that has been abandoned and, until now, unusable," said Watson.

The 27-acre facility would be capable of producing 5-10 megawatts of electricity for Brockton residents and other electricity consumers. "This is a huge step in the right direction for our community and brings

with it the potential to attract high tech businesses and jobs to the city," said Brockton Mayor Jack Yunits.

RET is also trying to get distributed generation systems into public facilities. It awarded \$776,900 to cover design costs for seven new or renovated "green" schools in Massachusetts. Districts receiving awards will utilize a variety of renewable and energy efficient technologies such as solar, wind and geothermal energy as well as fuel cells and biomass technology in their school construction and renovation projects. The seven grant recipients include: the City of Salem, the Beverly School Department, the City of Brockton, the City of Newton, the City of Somerville, Williamstown Public Schools, and the City of Waltham. "With Renewable Energy Trust and Department of Education assistance, we will more fully incorporate renewable energy technologies and high-

performance design features into the new Williamstown Elementary School," said Paula Consolini, chairwoman of the Williamstown school committee. "With renewable energy and other energy efficiencies, we can build a healthier and more comfortable learning environment for our children - and we can do it economically."

While the amounts handed out so far seem small compared to the \$300 billion dollars currently spent on gas and electricity, the RET thinks its efforts will bear fruit. "It is necessary for us to stand ready to prime the pump," said Adams. Adams said he sees a lot of potential in these technologies, particularly the solar and fuel cell industries. "The solar industry is a kind of dream industry. It's growing at about 30 percent a year," he said. "And the fuel cell industry is burgeoning. The technology is right on the edge, it's just coming into its own."

BIOGAS, CONTINUED FROM PAGE 7

such as microturbines and fuel cells is not exactly new. In 1998, the New York Power Authority (NYPA) implemented the Western Hemisphere's first fuel cell power plant to run on biogas. The 200 kW UTC fuel cell, funded in part by the EPA and the DOE, uses as fuel the anaerobic digester gas (ADG) that is a renewable byproduct of the wastewater treatment process at the Yonkers Wastewater Treatment Plant. The heat produced as a byproduct of electrical generation from the fuel cell is used locally at the sewage treatment plant for heating or cooling to further reduce the facility's energy needs. In addition to the Yonkers fuel cell project, the New York Port Authority helped install two 30 kilowatt microturbines at a wastewater treatment plant at Lewiston, New York. The microturbines, like the Yonkers fuel cell, have been adapted to convert ADG into electricity.

NYPA isn't the only company looking at biogas as a fuel for distributed generation. Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) has initiated a \$1 million program called the Green Gasifier Generator project. "The project combines CSIRO wood gasification expertise with advanced United States microturbine generator technology and local manufacturing capability," says Dr Glen Kile, Chief, CSIRO

Forestry and Forest Products.

The project aims to produce electricity in the 30-200 kW range, using a CSIRO wood-gasification process and Capstone's microturbine technology. "The project will demonstrate the generation of electricity from sustainable and renewable wood and provide information to confirm the prospect for commercial viability of localized generation of electricity," says Dr Kile. "Green Gasifier Generators could be located in remote and regional areas close to sustainably produced biomass resources and provide a constant supply of renewable energy," he says.

The Los Angeles Department of Water and Power (LADWP) is also starting to use biogas as a distributed generation fuel. In August 2001, LADWP began operating a Capstone microturbine-powered landfill gas system at Los Angeles' Lopez Canyon landfill. This 50-microturbine system will convert methane gas collected at the site into 1.5 megawatts of electricity. "The microturbine project will create energy from an innovative source and help reduce pollution," said David H. Wiggs, LADWP General Manager. "LADWP is proud of this power plant. It shows that thinking outside conventional standards can bring about creative ideas to help us deal with both energy and ecological issues."

Funds come from a LADWP commit-

ment to spend \$14 million on clean air projects in exchange for the right to exceed state air pollution limits while producing power for California's tight energy market. The transformation of landfill methane gas into clean energy will eliminate 10,000 pounds of NOx emissions annually.

Given the large number of biogas sources available, it is likely that eventually it will be a major source of fuel and help distributed generation penetrate the market.

CANADA, CONTINUED FROM PAGE 4

worldwide by 2011. In addition, just the North American fuel cell industry is expected to provide 108,000 direct and indirect jobs in the stationary sector, and 33,000 direct and indirect jobs in the transportation sector by then.

Britton says a national strategy for the development of the fuel cell industry will help the government achieve its goal of elevating Canada to one of the world's top five countries for technology innovation by 2010, and make it easier to meet the country's targets for reducing green house gas emissions. If Canada, wants to maintain its lead, it better crank up the money machine, because at least financially, it does appear to be falling behind.

COMPANY PROFILE: IDATECH

IdaTech (formerly Northwest Power Systems) was founded in 1996 to develop solutions to some of the technological hurdles facing the fuel cell industry. In 1999, IdaTech joined the IDACORP, Inc., family of companies that include Idaho Power Company, a regulated utility, and Idacorp Technologies, a non-regulated subsidiary of IDACORP. Today, the company is owned by IdaCorp, Inc. (72%), Tokyo Boeki (1%), and the three original founders -- entrepreneur Alan Guggenheim (12%), scientist David J. Edlund (12%), and chemical engineer William A. Pledger (3%).

IdaTech is a leader in the development of fuel cell systems and components for stationary and portable electric power generation. IdaTech and its strategic alliance partners are exploring a number of commercial applications, including: portable power units, UPS, consumer power products, and home energy systems.

IdaTech's first commercial products are comprised of three major subsystems: the proton-exchange membrane (PEM) fuel cell; a fuel processor for converting conventional fuels into the hydrogen needed

by the fuel cell, and the balance of plant components. The balance of plant integrates the processor and fuel cell and converts the power into household current. The systems produce electricity and heat with very little noise, vibration or emissions. At the heart of the fuel cell system is their patented fuel processor, capable of converting conventional fuels, including methanol, natural gas, propane, diesel and kerosene into 99.9% pure hydrogen with less than 1 part per million carbon monoxide.

A number of Pacific Northwest utilities are currently testing IdaTech's three-kilowatt residential fuel cell system, which is expected to hit the commercial market in 2003. The fully automated system, about the size of a chest freezer, quietly and cleanly converts methanol into enough electricity to power a home or a small business.

IdaTech is on track to commercialize the first of its 1-kilowatt, 3-kilowatt, and larger fuel cells for UPS, emergency power, and portable and stationary applications in late 2002, and residential applications in 2003.

IdaTech has a number of alliances to help it reach its objectives. One is a strategic alliance with Tokyo Boeki to introduce its components and systems to markets in Japan and Asia. The agreement includes a multi-year, multi-million dollar purchase agreement that includes joint development to "localize" IdaTech's fuel cell technology for the Japanese market.

Another agreement that IdaTech has entered into is with the Bonneville Power Administration (BPA) to help in the testing and development stage for IdaTech's fuel cell systems. After making any necessary adjustments to the first 10 "alpha" units installed and tested by BPA, IdaTech will implement improvements and commence shipments of the remaining 100 "beta" units.

Finally, IdaTech has entered into an agreement whereby Sandia National Laboratories has accepted three proton-exchange membrane fuel cells that they will test. The first phase of this program is to develop a fuel cell that will produce 3-5 kW, sufficient average electrical power for a single house, in a laboratory using electrolytic or bottled hydrogen.

TECH BRIEF: THIN FILM PHOTOVOLTAICS

Most commercially available photovoltaic (PV) modules are made from wafers of very pure monocrystalline or polycrystalline silicon. Such modules can attain efficiencies of up to 18% in commercial manufacture and over 20% in the laboratory. However, the silicon wafers used to make them are relatively expensive, making up 20-40% of the final module cost. Although silicon is highly abundant, making a very pure wafer suitable for solar cell manufacture requires much energy and is therefore relatively costly. Moreover, a solar cell made using a 300-400 micrometer thick wafer generates 90% of its energy from the top 15-20 micrometers. The rest of the wafer is required simply to hold the cell together.

The alternative to these "bulk silicon" technologies is to deposit a thin layer of semiconductor onto a supporting material such as glass. Various materials can be used such as cadmium telluride, copper-indium-diselenide and silicon. Thin film solar cells made from cadmium telluride or copper indium diselenide have yet to be fully commercialized, but offer some

promise of achieving low costs with reasonably good performance.

Thin film PV modules require very little semiconductor material and have the added advantage of being easy to manufacture. Rather than growing, slicing, and treating a crystalline ingot; thin layers of the required materials are sequentially deposited. Several different deposition techniques are available, and all of them are potentially cheaper than the ingot-growth techniques required for crystalline silicon. Best of all, these deposition processes can be scaled up easily so that the same technique used to make a 2-inch x 2-inch laboratory cell can be used to make a 2-foot x 5-foot module. In addition, single-crystal cells have to be individually interconnected into a module, but thin-film devices can be made monolithically (as a single unit).

Unlike most single-crystal cells, the typical thin film photovoltaic module does not use a metal grid for the top electrical contact. Instead, it uses a thin layer of a transparent conducting oxide (such as tin oxide). These oxides are highly transparent

and conduct electricity very well. A separate antireflection coating may be used to top off the device, or the transparent conducting oxide may serve this function as well.

Today, photovoltaic (PV) modules are sold at about \$3-\$5/Wp (Peak Watt). PV systems are priced at about twice this figure. However for PV to become truly competitive with central generation, their cost must fall to \$1-\$3/Wp for PV systems. In order to make this happen the cost of the modules must fall significantly. One of the most promising technologies for making this happen is thin film.

The US Department of Energy cost goal for thin films is about \$0.33/Wp, which is based on a module efficiency goal of about 15% and module manufacturing costs of about \$50/m². However, thin film PV technologies face a number of hurdles as they advance towards this goal. To reduce module prices, progress is needed on three fronts: the performance of the modules (efficiency, or W/m²), their direct manufacturing cost (\$/m²), and increased volume production.

DISTRIBUTED GENERATION IN THE NEWS

Ballard Introduces High Speed Gas Genset

Ballard Power Systems' Electric Drives & Power Conversion Division introduced its first high-speed natural gas fueled generator set (Ecostar) capable of producing 80 kW for standby and back-up power applications. The Ecostar ES080-42N-S genset is based on the 4.2L Ford V6 natural gas engine and operates at double the speed of conventional gensets to produce nearly twice the power. By increasing the engine speed, Ballard has achieved the highest power density of any 80 kW genset. As a result, the Ecostar genset also has the lowest cost per kilowatt of any genset at this power level. Ballard and Ford collaborated to increase the speed and endurance of the Ford 4.2L V6 natural gas engine and Ballard integrated this engine with the generator, electronics and control systems. The Ecostar genset provides the highest fuel-to-wire efficiency and lowest emissions of any genset primarily due to the Ford natural gas engine's efficiency (32%) and the Engine Performance Module that controls and optimizes engine performance continually. The list price of the ES080-42N-S is \$15,700 with delivery in one to four weeks. Service and warranty are available from more than 500 authorized distributor service centers across the United States. Targeted markets include agricultural, light-industrial and large residential standby applications.

Solar Power Hitting Home Depot

AstroPower has begun selling its residential solar-power systems at two Delaware Home Depot stores as it continues to try to take advantage of the nation's renewed interest in alternative power and state tax incentives. The home systems, which cost between \$15,000 and \$25,000, are available at Home Depot locations in Glasgow and Christiana - the first stores on the East Coast to offer the products. AstroPower, which began selling the systems at three California Home Depots last summer, has been expanding its sales program and plans to offer the product at more than 60 Home Depot stores by the end of the summer. Delaware has set aside \$4 million toward its Environmental Incentive Fund, which gives certain homeowners a one-time rebate of up to 35 per-

cent of the cost of an alternative power system. The rebate is available only to Conectiv customers because they are the only ones who pay into the fund. Anticipating questions Delawareans might have about solar-power systems, AstroPower has placed representatives in information booths outside the entrances to both stores.

Capstone Releases Pre-Engineered CHP Solution

Capstone Turbine Corporation released a new microturbine-driven combined-heat-and-power (CHP) product, achieving a third-quarter milestone goal. The company anticipates that its Pre-Engineered CHP Solution product, referred to as a "CHP kit" will result in a reduction in total installed cost. Prior to this solution packaging, Capstone distributors and service providers needed to draw major components, technical support and individual product warranty processing from several different sources. The Pre-Engineered Capstone CHP Solution product enables a single point of contact -- Capstone Turbine's Customer Service division -- for equipment ordering, everything-at-once delivery, consolidated engineering details and documentation, technical support for all product components and their integration, and warranty administration. The enhanced uniformity and documentation is also anticipated by Capstone to help streamline site permitting and incentive program processing.

Co-op Installs Plug Power Fuel Cell

Georgia's first residential fuel cell has been installed by Flint Energies to provide heat and electricity to its Service Center facility in Warner Robins. The 5 kW fuel cell, manufactured by Plug Power Inc. of Latham, New York and purchased from GE Fuel Cell Systems LLC, was installed and commissioned in less than 4 days in June. Flint Energies is currently the only GE Fuel Cell Systems distributor in Georgia. Flint has built a network of 13 other Georgia electric cooperatives to market and distribute fuel cells in 100 central and South Georgia counties. "Fuel cells will be an important part of Flint's electric service in the future," said Joe Cade, Flint Energies President/CEO.

DTE Provides SOC Services For STM

DTE Energy Technologies Inc. announced an agreement with STM Power to provide energy|now(TM) System Operations Center (SOC) services for monitoring and controlling 50 beta prototype PowerUnits. The 50 PowerUnits will be installed by the end of the year in both domestic and international locations. The services provided by the energy|now SOC include installation of all site-related equipment, communications to the SOC and back-end systems necessary to process and analyze operating data. The energy|now SOC will monitor and control the units according to field test specifications provided by STM Power. The system also will provide STM Power with advanced reporting capabilities necessary to validate their testing specifications.

SMP Announces \$3 Million PEM Program

Superior MicroPowders announced it has been granted a NIST ATP (National Institute of Standards and Technology Advanced Technology Program) award for the development of next generation membrane electrode assemblies (MEAs) for polymer electrolyte membrane (PEM) fuel cells. Under this \$3 million, three-year program, SMP will develop MEA technology designed to solve the critical problems associated with mixed gas reformat streams. This latest award is a three-year effort designed to address the critical interdependency between the MEA and reformer. The program focuses on the development of novel high temperature membranes and advanced MEA manufacturing methods including chemical vapor deposition (CVD) and chemical vapor infiltration (CVI). Superior MicroPowders will lead a team that develops novel high-temperature catalyst-coated membranes (CCMs) and MEAs based on a new continuous manufacturing process to produce the membranes and electrode assemblies in high volumes at low cost. The proposed CCMs will operate at much higher temperatures than current systems, use less platinum and tolerate CO levels much higher than conventional polymer electrolyte fuel cells. In addition, they would require much simpler water-management systems.

FINANCIAL HAPPENINGS

Nuvera Fuel Cells, Inc., and **Air Liquide** announced their agreement to end their joint venture in the company **Axane**. Axane was formed in February of 2001 to develop and market power production systems based on fuel cell technology for various applications. Although both companies cited a successful joint development phase, each company will separately pursue fuel cell hydrogen technology development. Air Liquide will continue these development activities within Axane as a 100 percent Air Liquide owned company.

Kyocera Solar, Inc. announced the sale of Kyocera Solar Argentina S.A., which is based in Buenos Aires, Argentina and includes a manufacturing operation in La Rioja, Argentina, to Fernando J. Salgado, a long-time employee and division manager. Terms of the sale were not disclosed. Salgado has re-named the company "**Solartec S.A.**," and has entered into supply/purchase and license agreements with Kyocera Solar, Inc. Under the terms of these agreements, Solartec will continue to market Kyocera solar products and manufacture specialty products for Kyocera Solar, Inc. Kyocera Solar, Inc. will continue to focus on providing quality solar-related products and solutions in the areas of residential and commercial grid-tie, industrial systems, and water pumping to its dealer/OEM customer base in both the U.S. and international markets.

DCH Technology announced that on July 9, 2002, as part of its deliberations on strategic options for the Company, DCH's Board of Directors approved the solicitation of offers to purchase its sensors and/or fuel cell divisions. DCH said that management, including the Board of Directors, will continue to evaluate the Company's position and the current and anticipated business climate in determining short term and future options. DCH also says that its management continues to have confidence in DCH's technology and the potential that this technology has to make a difference in this nation's and the world's energy needs.

Ballard Power Systems Inc. shares plunged as much as 23 percent after an H.C. Wainwright analyst cut his rating on the stock, saying the company may spend all of its cash. The U.S. shares of the Canadian maker of fuel cells for cars and electricity generation fell \$3.31, or 22 percent, to \$11.82 in midafternoon trading on

July 15 after touching \$11.60. The Canadian shares declined C\$5.08, or 22 percent, to C\$18.15. The Burnaby, British Columbia-based company's stock price may fall below \$10 because it's using up cash and may enlarge the size of a proposed share sale, analyst David Kurzman said in this week's issue of Barron's. "You've got a company with no mass commercially viable product," Kurzman, who rates the stock "sell" and doesn't own it, said in an interview. "I expect the company to continue to burn through its cash." Ballard Power will spend about \$350 million by the end of 2003, Kurzman said. "They shouldn't have too much left by the end of next year," he said. The company's main product, a fuel cell, is expensive to build and unlikely to be widely used in vehicles for several years, Kurzman said.

ATS Automation Tooling Systems Inc. received a \$29.5 million conditionally repayable Technology Partnerships Canada (TPC)/Climate Change Action Fund (CCAF) investment. The initiative will advance the development of a unique technology for the production of photovoltaic energy. ATS Automation Tooling Systems Inc., of Cambridge, Ontario will undertake its final stage of development of a new form of solar energy technology made up of thousands of tiny silicon spheres bonded in a flexible aluminum foil matrix - referred to as Spherical Solar(TM) power. ATS will work to develop the photovoltaic technology and a prototype manufacturing line capable of producing 20MW of the solar products yearly. This manufacturing line would be a fifth to a tenth the size of a commercial factory. Spherical Solar(TM) technology was origi-

nally developed by Texas Instruments Inc. As an equipment supplier, ATS was a key member of the research team. Through its subsidiary Matrix Solar Technologies, ATS acquired the intellectual property and equipment related to this project. Since then, ATS has developed an optical enhancement that will reduce manufacturing costs. The current project will complete research related to the enhancement, establish a new R&D centre for Spherical Solar(TM) technology; and design and build the first prototype manufacturing system. The Government of Canada's investment is composed of \$25.5 million from Technology Partnerships Canada and \$4 million from the Technology Early Action Measures (TEAM) component of the Climate Change Action Fund.

ANALYST'S CORNER

Ballard Power Systems Inc. was raised to "buy" from "hold" by analyst MacMurray D. Whale at National Bank Financial.

Ballard Power Systems Inc. was raised to "market perform" from "underperform" by analyst Andrew Bradford at Raymond James. The 12-month target price is C\$30.00 per share.

Capstone Turbine Corp. was downgraded to "monitored" from "neutral" by analyst David H Kurzman at H.C. Wainwright.

Hydrogenics Corp. was downgraded to "hold" from "buy" by analyst John Clarke at Octagon Capital Corporation. The 18-month target price is C\$8.50 per share.

Ballard Power Systems Inc
as of 19-Jul-2002

Splits: ▼

